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ABSTRACT

This paper surveys research in the field in an attempt to determine what level of mastery of basic skills is required to do a particular job, what level vocational education students generally attain, and which instructional techniques are effective in improving vocational education students' basic skills. In the first of three sections, claims and evidence concerning the relationship of basic skills to employability and occupational competence are discussed; while in the next section, information on the level of acquisition of reading, writing, and arithmetic skills of vocational education students in secondary schools is presented. Characteristics of remedial efforts to improve vocational students' basic skills are discussed in the third section. Results of the literature search suggest the following: (1) Proficiency in certain reading and computational skills is required for performance in all types of occupations. (2) Information is not yet available on the level of basic skill acquisition of students in different vocational programs; however, it is known that vocational education students perform below average in reading comprehension, vocabulary, and mathematics. (3) Available information leaves unanswered questions about successful efforts to improve the basic skills of vocational students, though inferences can be drawn from research conducted on literacy programs for adolescents and adults. The study also makes recommendations for improving vocational students' basic skills.

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Basic Skills Proficiencies of Secondary Vocational Education Students

U.S. DEPARTMENT OF HEALTH,
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FOREWORD

The Vocational Education Study Project has already made clear its intention to publish papers, accounts of inquiries, and the results of selected research projects emerging from its work. These publications are in addition to The Interim and The Final Reports on the study which the National Institute of Education is charged with undertaking by the Education Amendments of 1976 (P.L. 94-482). The Institute, as that law requires, transmitted The Interim Report to the President and the Congress on September 30, 1980. The Institute will be transmitting the Final Report on the mandated study to the President and the Congress no later than September 30, 1981.

Louise Corman's paper on Basic Skills Proficiencies of Secondary Vocational Education Students deals with a subject that has won national attention and is acutely relevant to key objectives of the pending Youth Act of 1980. It presents information that should be highly useful to policy makers, as well as to educational officials, administrators, and teachers. In relating both how much and how little is known about the basic skills proficiencies of secondary vocational education students, it emphasizes the importance of a heightened research effort and of prudence in the adoption of remedial measures.

Henry David
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PREFACE

A foundation in the basic skills of reading, writing, and computing is widely regarded as essential for a student's subsequent learning both at work and at school. Although these skills are considered to be critical for successful entry into the labor market, for upgrading skills, and for retraining, little information is available on the level of basic skills attained by vocational education students in secondary school. President Carter's educational initiative, a major component of the Youth Act of 1980 in bills before the House and Senate in the Spring of 1980, aims at improving the basic literacy and computational skills of low-income and minority youth as a partial means of reducing youth unemployment. The recent announcement of this initiative renders information on vocational education students' basic skills especially timely.

What level of mastery of basic skills is required to do a particular job? What level do vocational education students generally attain? Which instructional techniques are effective in improving vocational education students' basic skills? In this paper information will be presented in an initial step toward answering these questions. The paper is divided into three sections. In the first section, claims and evidence concerning the relationship of basic skills to employability and occupational competence are discussed. In the next section, information on the level of acquisition of reading, writing, and arithmetic skills of vocational education students in secondary school is presented. Characteristics of remedial efforts to improve vocational students' basic skills are discussed in the third section.

I would like to acknowledge the thoughtful comments that I received from members of the Vocational Education Study staff on an earlier draft of this paper. I am especially grateful to Dr. Henry David, Director of the Vocational Education Study, for his thorough and careful reading, and to Robert Stump, formerly of the Program on Teaching and Learning, National Institute of Education, for his suggestions of sources of information and critical and informed review. The ideas and opinions expressed are mine and do not necessarily represent the views of the National Institute of Education or of the Department of Education.

Louise Corman
Vocational Education Study

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BASIC SKILLS PROFICIENCIES OF SECONDARY VOCATIONAL EDUCATION STUDENTS

Louise Corman

On January 10, 1980, President Carter announced plans for a \$900-million educational initiative targeted at improving basic literacy and computational skills of low-income and minority youth. This initiative, included in the Youth Act of 1980 in bills before the House (H.R. 6711) and Senate (S. 2385) during the Spring of 1980, developed in part from a review of research and program experience of vocational education and CETA programs conducted by the Vice President's Task Force on Youth Employment and the White House Domestic Policy Staff. Underlying the Youth Act of 1980 is the belief that "lack of basic communication, comprehension and computational skills is the most serious barrier between these young people and successful entry into the labor market" (Youth Employment Initiatives, Note 1, p.3).

Ability to read with understanding, write, and compute are generally regarded as critical to subsequent learning and the employability of a student entering the labor market, upgrading present skills, or being retrained. The importance of these basic skills to schooling and work is widely recognized, but the extent to which these skills are mastered by vocational education students in secondary school has rarely been investigated. Moreover, virtually nothing is known about differences in competence in basic skills among students in different vocational programs.

It is likely that a vocational education student needs sufficient competence in basic skills to perform on a job, benefit

from on-the-job training, enroll in a postsecondary education program, or study a correspondence course. A foundation in basic skills is thought to be necessary for subsequent learning and for mastery of higher-level quantitative or qualitative skills which may be required for advancement or performance in particular jobs, such as printing or drafting.

What level of mastery of basic skills is required to do a job? What level of competence in these skills do vocational education students generally attain? Until these questions are answered, it will not be known whether vocational education students are more or less well-prepared than other students for the work and schooling in which they will participate later in life.

The purpose of this paper is threefold: to examine claims and evidence attesting to the relationship of basic skills to employability and occupational competence; to provide information on the level of reading, writing, and arithmetic competence of vocational students in secondary school; and to describe characteristics of remedial efforts to improve the basic skills of vocational education students. The ultimate goal of this inquiry is to improve knowledge of the nature of basic skills required in different jobs, the degree to which vocational students master those skills, and the methods by which schools can best teach the needed skills these students have not acquired.

Basic Skills, Employability, and Occupational Competence: Claims and Evidence

The assertion that proficiency in basic skills is essential for those seeking and holding jobs is rarely disputed. Literacy

in particular, whether traditionally defined as the ability to read and write a simple statement, or as functional literacy, which varies with the demands placed on an individual to function effectively "in his group and community" (Harman, 1970, p. 227), is said to be critical to employability and competence in a job. The acquisition of basic skills in secondary school, particularly on the part of vocational education students, is thought to be especially important in reducing unemployment rates of minority and disadvantaged students.

In the early vocational education legislation, the distinction between vocational and academic education was promoted. Under the Smith-Hughes Act of 1917, Federal aid for vocational education was restricted to instruction in vocational courses. The need to broaden vocational education beyond instruction in specific occupational skills to include general education was expressed by the committee appointed by Franklin Roosevelt to review vocational education (Russell Report of 1938, reprinted in Lazerson & Grubb, 1974). Recognition of the importance of basic skills to vocational education students grew in the 1960's, as concern with high unemployment among minority groups rose. The report of the Panel of Consultants appointed by President Kennedy in 1961 stated that "general education--language and arithmetic skill, plus basic knowledge of the world about us--itself contributes indispensably to occupational competence. Vocational education and general education are complementary and equally important to individual occupational competence" (Panel of Consultants on Vocational Education, 1963, p. 264). The Vocational Education Amendments of 1968 supported the Federal commitment to this broad view of vocational education by including in the definition of vocational education "remedial or related academic and technical instruction...." (P.L. 90-576, sec. 108(1)).

The belief that occupational skills and basic skills together contribute to occupational competence is reflected in the priorities recently set forth by the Office of Vocational and Adult Education in the U.S. Department of Education (formerly the Bureau of Occupational and Adult Education), which holds that "Basic educational skills are essential to all persons, and vocational education must complement basic skills/remedial programs if persons are to succeed in vocational education programs....Both academic and vocational programs should complement and further one another in producing persons who are prepared to function responsibly in a working world" (Federal Register, June 13, 1979, p. 33961).

Going beyond the notion of complementarity, the Carnegie Council on Policy Studies in Higher Education has recommended that "The basic vocational (and academic) skills for the high school to concentrate on are the skills of literacy and numeracy--and good work habits" (Carnegie Council on Policy Studies in Higher Education, 1979, p. 24). Emphasis on literacy instruction in the vocational curriculum has been recommended by Lester Thurow (1979), who argued that the three most important functions of vocational education should be to provide literacy training, because the cost to employers of providing this training to workers is too high for them to meet; to instill good work habits, especially industrial discipline; and to create salable skills. He reasoned that employers tend to hire workers with the lowest potential training costs; therefore, if vocational education furnished graduates with literacy skills and good work habits, employers would not incur the expense of this training and vocational education students would have a better chance of being hired than students who had not acquired these attributes.

That employers believe literacy instruction is the school's responsibility has been documented by a survey of executives of 610 companies with 500 or more employees (Lusterman, 1977). This survey indicated that business leaders are reluctant to provide services they think schools should provide (pp.62-65). Fifty-four percent of the sample believed that schools were deficient in teaching reading, writing, and other language skills; nevertheless, only eight percent of the companies sponsored courses in basic education for employees, in contrast to 60 percent which offered management or supervisory training and 54 percent which offered functional or technical training, although the latter may have included some instruction in basic skills (p.49).

In addition to employers, many others with increasing frequency are calling for greater emphasis on basic skill instruction as preparation for employment. Willard Wirtz, former Secretary of the U.S. Department of Labor, and Kenneth Clark, psychologist and educator, have recently emphasized the need for instruction in basic skills as job training for inner-city and minority youth (Education Daily, Oct. 24, 1979; Education Daily, Oct. 2, 1979). In congressional testimony on youth unemployment, Dr. James E. Bottoms, Executive Director of the American Vocational Association, asserted that basic skill training is closely associated with employability (Bottoms, Note 2), and Isabel Sawhill, Director of the National Commission for Employment Policy, stated that "Improvement of basic educational competencies for those who have not mastered the three Rs is critical, and will become all the more important as our economy becomes more technologically sophisticated and paper-oriented" (Sawhill, Note 3, p. 12). In addition, in the report setting forth the reasoning behind President Carter's youth initiatives, it is noted that since 1950 the number of service jobs has steadily increased and is expected

to continue to increase (Youth Employment Initiatives, Note 1). Advancement in service sector firms, which are described in the report as "white collar, office oriented and technical," is said to depend largely on basic communications skills, in contrast to advancement in industrial firms which allow people to take entry-level jobs and advance on the basis of seniority and experience.

Claims abound that education in basic skills is necessary to prepare vocational students to obtain and perform jobs; however, certain critical questions about the relationship of basic skills to job performance remain to be answered. For example, what level of proficiency in the different basic skills is required to perform the tasks of particular occupations competently? Is the proficiency required in learning how to perform these tasks greater than that required to actually do them once learned? Is the proficiency in basic skills required to obtain a job greater than that required to do it competently? That is, do employers tend to require a higher level of literacy of prospective employees than is necessary to do the job, because the employer uses literacy as a proxy for other attributes which he considers important, such as ability to get along with professional co-workers? Similarly, how often do employers cite inadequate literacy, rather than a personality characteristic of the employee which the employer finds objectionable, as a reason for firing an employee?

To the writer's knowledge, only the first of these questions, that concerning the level of proficiency of basic skills required for different occupations, has been subject to research in industrial settings. Underlying the recent research on basic skill requirements of different jobs is the idea that basic skills are critical to employability and occupational competence because these skills are "transferable" in the sense that they have

applicability to a broad range of occupations and jobs (Pratzner, Note 4; Stump, Note 5). The wide applicability, or transferability, of basic skills is especially important in light of the fact that many people change occupations several times and that labor market demands change.

As recently as five years ago very little was known about the basic skill requirements of different occupations. Shortcomings of existing indicators of basic skill requirements were pointed out by Sticht (1975), who noted that the U.S. Department of Labor General Educational Development and corresponding Reading Grade Level (RGL) required to perform different jobs are not objectively determined and that the RGL permits "only the coarsest differentiation" of literacy requirements of jobs (p. 90). The Dictionary of Occupational Titles (fourth edition) provides ratings of the complexity of tasks which workers in many occupations perform that make use of data (including numbers, words, symbols, and concepts), people, and things. These ratings, however, permit only indirect inferences about the level of reading, writing, and arithmetic skills required in jobs. Although inferences concerning levels of arithmetic reasoning and of vocabulary required in certain jobs could conceivably be drawn from a screening test like the General Aptitude Test Battery (GATB), it is not known to what extent skill levels used for hiring reflect inflated requirements, or to what extent a deficiency in a skill measured by the GATB can be compensated for by proficiency in another skill, which the GATB may or may not measure. For example, it is possible that a good sense of spatial relations may compensate for poor arithmetic reasoning in certain occupations such as drafting.

One reason that current literacy requirements of jobs are not generally known is that employers in some industries may avoid publishing screening tests or scoring requirements because of executive orders and Supreme Court decisions issued in relation to

the Civil Rights Act of 1964 (Mikulecky & Diehl, Note 6). Under these rulings, if a test is shown to have the effect of diminishing opportunities for employment of a minority group, an employer can be required to stop using the test, change it to eliminate the adverse effect, validate it, or provide an alternative assessment procedure. (See, for example, Uniform Guidelines on Employee Selection Procedures, Equal Opportunity Commission, sec. 6, p. 4010 06, 1978; Albemarle Paper Company v. Moody, 1975; and Boston Chapter, National Association for the Advancement of Colored People v. Beecher, 1974).

In the United States much of the research on literacy requirements of jobs has been conducted in the military. During the late 1960's, admission of marginally literate men to the Army to meet the need for increased numbers, as well as concern of minority groups that literacy requirements of jobs were inflated, caused the Army to reassess literacy requirements of job tasks. By 1971, Sticht and his associates had developed the Job Reading Task Test (JRTT) for the Army to estimate the general reading level required to do certain jobs (Sticht, 1975). The test was constructed by testing the reading levels of job incumbents, correlating their scores with scores on the JRTT, and establishing cut-offs on the JRTT for personnel in different job categories.

Sticht (1978) reported that 75 percent of the reading tasks performed by Navy personnel in 10 job fields were carried out for the purpose of locating information in order to do a task ("reading-for-doing"), and many were performed repeatedly. In contrast, the majority of reading tasks performed by students in Navy training programs required learning from text and made far greater cognitive demands than reading-for-doing tasks. Sticht found a strong relationship between reading ability of job incumbents and their ability to perform job-related reading tasks.

The most extensive research on basic skill requirements of jobs in industry has been conducted by the Canada Employment and Immigration Commission (Generic Skills, 1977). This research, called the Generic Skills Project, provides both a methodology for determining skill requirements of different jobs and evidence in support of the idea that reading, writing, and arithmetic skills are applicable to a wide range of occupations. The need to examine the commonality of skills rather than the uniqueness of occupations, as stated in the Project's report, has implications for vocational education:

It is increasingly recognized that the rate of technological change, as well as the fluctuations of specific labour markets, requires a degree of training and flexibility possessed by relatively very few workers. The problem lies not in a resistance to change on the part of the labour force, but rather on the content of the curriculum which trains a person for a specific job rather than for a family of jobs, and the nature of the credentials for employment which fail to recognize, in this age of specialization, that many skills are transferable to a variety of occupations....Rather oddly, while skill training has been developed and carried out as if every occupation or job had unique skill requirements, academic pre-occupational training has proceeded as if every occupation had the same academic requirements. (p. 1)

In this project, workers in 49 occupations and supervisors in 28 of those occupations were given interviews and questionnaires to determine their performance of job tasks in the following domains: arithmetic and mathematics, communication (including reading and writing), reasoning, and science. The researchers sought

information on tasks workers perform rather than on the cognitive processes used to perform the tasks. The assumption is made, but not explicitly stated in the report, that performance of these tasks requires certain skills. It cannot be assumed, however, that the numerous tasks investigated in this project require skills which are independent. For example, tasks requiring reading comprehension, which denotes the ability to associate meaning with symbols in a given context, are included in the domain of communication, but reading comprehension is probably also required to perform many of the reasoning tasks, such as deducing informational needs. Basic skills appear to be required in all of the domains of tasks surveyed in this project.

Sample sizes of workers and supervisors in four surveys ranged from 300 to 970. Reported correlations between workers' and supervisors' responses were above .95. Occupations were grouped into 10 occupational families (clerical, engineering technologies, health, sales, service, machining, assembly, construction, motor transport, and farming), and detailed charts have been provided to indicate the proportion of occupations in each occupational family in which each task is performed by workers. Lists of tasks performed in various occupations were also provided, with the aim of assisting development of training modules and providing counselors with information on skills that may be transferable to particular occupations.

Results indicated that in most or all occupations in all 10 occupational families, workers were required to read business forms, notes, letters, memos, charts, tables, and technical or reference books for the purpose of finding facts and deciding how what they read applies to their jobs. Writing tasks performed by most or all workers in all occupational families consisted of completion of forms and brief memos, letters, or reports. Other communication tasks performed in most or all occupations in all

occupational families were attentive listening, carrying out task-oriented conversation, expressing one's point of view, seeking information, and passing on task directions. Elementary arithmetic computation tasks, such as measurement with whole numbers, were performed by most or all workers in all occupational families. Reading comprehension for evaluative purposes, writing technical reports, and geometric and algebraic operations were rarely done on the job. The ability to communicate effectively and the ability to display logical thinking were significantly related to supervisory status; mathematical competence was not.

Efforts to determine basic skill requirements of jobs in industry in the United States are very recent and are being conducted with very small samples. Two studies are presently underway, both of which focus on literacy. One study began in September 1979 with a one-year grant from the National Institute of Education (NIE) to Larry Mikulecky at Indiana University. In this study, 149 workers and 100 students in Indianapolis (50 of whom attend vocational schools) are being interviewed and tested to determine literacy demands of jobs, competencies of workers and students, reading purposes, and strategies used by workers and students to meet literacy demands (Mikulecky, Note 7). Strategies include rereading material, associating information with something the reader already knows, and underlining main points in a text. The full range of occupational categories listed in the Dictionary of Occupational Titles is represented by the sample of workers. A pilot study by Mikulecky and Diehl (Note 8) of 107 workers (ranging from unskilled to professional) indicated that nearly all workers performed some form of reading and that many job-related reading tasks (40 percent) involved obtaining facts and following directions applicable to the job. Twenty-six percent of job-related reading tasks involved skimming material to make decisions about its use, 23 percent involved incidental learning of the

material as a reference for doing a task, and 11 percent involved retention of the material through the use of particular strategies, such as outlining key points or repeated processing of information in the text. More than half the workers (52 percent) said that they would reread material required to complete a task if they had to repeat the same task; they did not try to learn the material when they read it the first time (Mikulecky & Diehl, Note 8).

A second study is being completed at Purdue University under grants from the Indiana Department of Public Instruction (Moe, Rush, and Storlie, Note 9). This study determined literacy demands by applying readability formulas to materials used by workers and by analyzing samples of workers' writings, such as letters. In addition, supervisors were questioned about mathematics skills used by workers on the job. Tasks of three workers in each of 10 occupations were surveyed, and specific reading and mathematics skills required of the three workers in each occupation have been identified.

Other Federally-funded research on basic skill requirements of jobs includes a study by Northrop Services, Incorporated, funded by the Navy and the Department of Education, Office of Basic Skills, to design basic skills curricula and accompanying diagnostic and evaluation instruments for four Navy occupational clusters--electronics, propulsion engineering, administrative/clerical, and operations. Basic skills of entering students are being assessed so that students can be placed in instructional modules appropriate to their skill levels. This study was initiated in January 1979 and will be completed in February 1981. Another study, funded by a small grant from NIE to the UCLA Graduate School of Education, began in September 1979 and will

relate the reading competencies required to graduate from high school to the reading demands of clerical and automotive jobs. Reading skills of 80 minority and bilingual workers who hold jobs in these fields will be examined in light of job demands.

Level of Acquisition of Basic Skills by Vocational Education Students

Basic skills are widely regarded as critical to obtaining employment. Moreover, recent research indicates that basic skills are applicable to many different occupations. It is therefore important to know the level of proficiency in basic skills that vocational students attain. It would be most useful to know the level of basic skill attainment of students in different vocational programs so that the gap, if any, between proficiency of students who are preparing for particular occupations and the demands placed on workers in those occupations can be identified and closed.

Available data on basic skills of vocational students come mainly from two sources: nationally representative student surveys and State assessments of high school students' basic skills. Since data on basic skills have not generally been collected for the purpose of examining proficiencies of vocational students, scores of students in different vocational programs have usually not been separately tabulated or, as in the case of the National Longitudinal Study of the High School Class of 1972 (NLS), were collected but not separately reported by occupational specialty. Assessments of writing ability of vocational students are rare, probably because reliable and valid essay tests are

expensive and time-consuming to construct and score. No data have been reported in the published literature on the basic skills of a cohort of vocational students upon entry to and completion of a vocational program, or on students in different types of vocational schools. Available data provide an indication of the levels of vocational education students' basic skills relative to those of students in other curricula, but data are not available to indicate the effects of vocational education on basic skill development over time.* There are probably additional data on the basic skills of vocational students in State education departments or large city school systems which have not been made generally available for research purposes.

Data on the levels of basic skills of students in different curricula are meaningful in the sense that basic skills are of intrinsic educational value to all students, regardless of whether those skills translate directly into economic outcomes. (The assumption is made that scores on basic skills measures are not dependent on prior knowledge of a content area to which students in the vocational curriculum may not have been exposed.) Comparison of basic skills of students in vocational and general curricula is appropriate for the additional reason that graduates of these two curricula may compete for jobs and therefore require similar levels of basic skills to be competitive in the labor market.

*Scores of tests of basic skills of students at three points in time from 1961 to 1967 when they were in the fifth through eleventh grade were reported by Hilton (Note 10). By the eleventh grade, the data point when students' high school curriculum becomes applicable, only 50 percent of the original sample remained. That sample is not representative of students in eleventh-grade vocational or general curricula and therefore these data cannot be taken as reliable evidence on effects of vocational programs on students' basic skills.

Mean scores on reading, writing, and mathematics tests of vocational students reported in national and State surveys are presented in Tables 1 and 2. If standard deviations have been reported, they appear as ± after the mean (M). (When scores are normally distributed, the mean is that score above and below which an equal number of scores fall. Thirty-four percent of the scores fall within one standard deviation below the mean, and thirty-four percent fall within one standard deviation above the mean.) Direct comparisons of scores reported in different surveys are prevented by the fact that different scoring formulas have been used and different skills have reportedly been measured (although skills called by different names cannot be assumed to measure different constructs, and vice versa). The method used to identify the vocational curriculum is noted in the tables, since large discrepancies have been found between students' self-reports and administrators' classifications of school records (Fetters, 1975). This fact indicates the difficulty in providing accurate identification of vocational students' curricula.

Mean reading comprehension, vocabulary, and mathematics scores of vocational students in the National Longitudinal Study conducted by the National Center for Education Statistics indicate that vocational students performed at about the same level as students in the general curriculum but scored approximately one standard deviation below academic students in all three. Other surveys revealed similar findings. Mean reading scores of vocational students in the Youth in Transition and Massachusetts samples were similar to the means of general curriculum students in these samples but well below the means of academic students. Mathematics scores of vocational students in the Massachusetts

Table 1

Mean Reading and Writing Scores of Students in Different Curricula

Source	Reading Tests				Writing Tests	
	NLS ^a	Youth in Transition ^b	Massachusetts ^c	Massachusetts ^c		
Sample	Grade 12 males and females	Grade 10 males	Grade 12 males and females	Grade 12 males and females		
Curriculum Identification	school record	self-report	self-report	self-report		
Skill	comprehension	vocabulary	comprehension (Gates Rdg. Comp)	vocabulary (GATB-J)	comprehension, vocabulary, locating information	writing
Score	number right minus guessing correction	number right minus guessing correction	number right of 43	number right of 60	percentage right	sum of two ratings (1-8)
						Essay #1 Essay #2
Vocational						
M	7.3 ± 4.5	4.5 ± 3.5	34.5 ± 5.7	16.6 ± 5.3	81.0	4.4 4.1
N	3819	3819	216	216	523	420 366
General						
M	7.8 ± 4.8	4.7 ± 3.7	36.2 ± 5.6	18.5 ± 5.8	83.4	4.6 4.8
N	4908	4908	468	468	591	427 403
Academic						
M	12.2 ± 4.2	8.4 ± 3.8	39.1 ± 3.7	22.9 ± 5.8	90.4	5.6 5.8
N	6624	6624	734	734	2112	1596 1567
Total Sample						
M ^d	9.7 ± 5.1	6.3 ± 4.1	—	—	86.3	5.2 5.3
N ^d	15625	15625			4038	3190 3053

^aFetters (1975).^bJohnston and Davidson (Note 11). Business and office students are not included in the vocational total.^cMassachusetts Assessment of Basic Skills 1978-79 (Note 12). Business and office students are not included in the vocational total.^dThis number may exceed the sum in the three categories above if other students were tested.

Table 2

Mean Mathematics Scores of Students in Different Curricula

Source	NLS ^a	NAEP ^b	Project Talent ^c	Minnesota ^d	Massachusetts ^e
Sample	Grade 12 males and females	17 year old males and females	Vocational high schools	17 year old males and females	Grade 12 males and females
Curriculum Identification	school record	self-report	(school means)	school or district record	self-report
Skill	math reasoning number right minus guessing correction	definitions, concepts, problem-solving, manipulation percentage of students who got a typical item right	computation, concepts, reasoning, application mean number right of 54	computation, concepts, advanced math knowledge	computation, concepts, measurement, graphs, estimation, statistics
Score					
Vocational					
<i>M</i>	8.7 ± 6.0	58.5	15.4	53.3 to 53.9	79.1
<i>N</i>	3819	2183	35 schools	9920	504
General					
<i>M</i>	9.5 ± 6.5	61.4	—	—	78.7
<i>N</i>	4908	3433			484
Academic					
<i>M</i>	17.3 ± 5.8	76.2	—	—	89.4
<i>N</i>	6624	3685			2047
Total Sample					
<i>M</i> ^f	12.7 ± 7.3	66.2	—	53.0	83.9
<i>N</i> ^f	15625	10614		15000	3916

^aFetters (1975).^bSome Preliminary Analyses of National Longitudinal Study Background Items Used in the National Assessment (Note 13).^cFlanagan, Dailey, Shaycoft, Orr, and Goldberg (1962).^dLudeman and Schneiderhan (Note 14). Number of vocational students is approximate and includes all students who have had one half-year or more of vocational courses.^eMassachusetts Assessment of Basic Skills 1978-79 (Note 12). Business and office students are not included in the vocational total.^fThis number may exceed the sum in the three categories above if other students were tested.

and 1976 National Assessment of Education Progress (NAEP) samples indicated this same pattern, as did writing scores of the Massachusetts vocational students.

In comparison to the total sample, means of vocational students in the NLS fell below total sample means in reading comprehension, vocabulary, and mathematics. Means of vocational students in the Massachusetts survey fell below total sample means in reading, writing, and mathematics. The NAEP mathematics assessment also revealed vocational students' means to be lower than those of the total sample. In these three surveys, means of general curriculum students, which were similar to those of vocational students, fell below total sample means, and means of academic students exceeded total sample means in all basic skills reported.

Scores of business students were separately tabulated in the Youth in Transition and Massachusetts surveys. Mean scores of business students in both surveys indicated that these students' average reading level was similar to that of other vocational and general students. Means of business students were 82.7 on the Massachusetts reading test, and 34.3 ± 6.5 and 17.3 ± 5.4 on the Youth in Transition comprehension and vocabulary tests, respectively. Although business students' average reading score was similar to that of other vocational students, average writing scores of business students were higher. Average scores of business students on the two writing tests in the Massachusetts survey (5.3 and 5.0) exceeded those of other vocational students and were similar to State means (5.2 and 5.3). In contrast, the mean mathematics score of business students in the sample (76.8) was lower than that of students in the other three curricula.

Reading scores of vocational students who transferred into the vocational curriculum from another curriculum before their

senior year of high school were separately reported in the Youth in Transition survey. In both comprehension and vocabulary, mean scores of these 165 students (34.7 ± 5.7 and 16.8 ± 5.6 on comprehension and vocabulary, respectively) were almost identical to those of the 51 students who had remained in the vocational curriculum throughout high school (33.8 ± 5.4 and 16.1 ± 4.4).

In the Minnesota assessment, mean mathematics scores of vocational students differed from those in the NLS and Massachusetts surveys in that the Minnesota vocational students' mean was the same as that for the total sample. These results must be interpreted cautiously, however, since means in the report of the Minnesota survey were not presented for students according to their high school curriculum. Rather, scores were grouped for students according to the number of vocational courses they had taken. Thus, the mean of "vocational" students with one year or less of vocational courses (almost half of all students who had had any vocational training) clearly reflected scores of students whose primary curriculum identification was not vocational. The range of means of students who differed markedly in their exposure to vocational courses, and presumably to other curricula as well, was quite narrow (52.3, 53.3, 53.9, and 53.6 for students with 0.0, .5 to 1.0, 1.5 to 2.0, and 2.5 to 3.0 years in vocational-technical courses, respectively). Mean mathematics scores by number of courses in each of seven vocational subject areas were presented in the Minnesota report. The data are very difficult to interpret, however, because many of the same students were counted in more than one cell and students whose primary curriculum was not vocational were included in the means by vocational subject area. Means on several sets of items, which were considered mathematics subskills in the report, were also presented, but many of these sets consisted of few items and reliabilities of the sets were not given. Conclusions based on means obtained with these sets of items must therefore be interpreted cautiously.

The current emphasis on competency testing led the Bureau of Occupational and Adult Education (now the Office of Vocational and Adult Education) to award a contract in 1979 to the American Institutes for Research to develop competency instruments in seven occupational clusters (agriculture, distributive, health, home economics, technical, trade and industrial, and business and office occupations). It is unfortunate that under this contract the opportunity will not be taken to provide separate measures of reading, writing, or computational skills, in view of the wide applicability of basic skills to different jobs and the limited information presently available on vocational students' basic skills.

In conclusion, available data on basic skills permit broad, descriptive statements about relative levels of attainment of students in different curricula. They do not permit comparisons among students in different occupational specialty areas or indicate strengths and weaknesses in ability to perform particular tasks, such as locating information in a text, which have been shown in the Generic Skills Project to have wide applicability across jobs. To date, no information exists on the extent to which those job-related tasks are reflected in measures commonly used in schools and in State assessments of basic skills. Furthermore, available data do not permit answers to questions concerning differential effects over time of high school curricula on students. Such questions would have to take into account the initial abilities and demographic characteristics of students in different curricula and would require assessment of their basic skills at different intervals. The most detailed reported data are provided in tables of basic skills scores by sex, race, and father's occupation of students in each curriculum in the NLS sample (Hilton & Rhett, Note 15), but these tables cannot be used to glean information on curricular effects.

Efforts to Improve Basic Skills of Vocational Education Students

It is known that vocational students need proficiency in reading and computational skills to obtain and perform a wide variety of jobs and that the level of basic skills attained by these students is relatively low. However, the best means for improving their competence in basic skills are not known. Information on effective methods for accomplishing this aim would, of course, be valuable in helping students attain the skills they need but have not acquired. There is information on efforts to improve basic skills of vocational students but most of it is not useful for determining which efforts are effective. Many curriculum guides are described but have not been evaluated. Others have been evaluated but with questionable methodological procedures that cast doubt on the findings. The few rigorous studies were conducted with small samples and, at best, offer only tentative clues to techniques that may be effective in raising vocational students' basic skills.

The claim is often heard that basic skill training provided in a vocational context results in improved skill levels among vocational students, because their motivation is increased through perception of the applicability of these skills to practical problems. Grasso (Note 16) raised an interesting question in regard to this claim. He cited Shaycoft's (1967) finding that reading comprehension of students in Project Talent who had taken many academic courses was found to improve to a greater extent than that of students with few academic courses. Grasso speculated that enrollment in vocational programs could either raise the level of basic skill attainment, as a result of increased motivation due to students' awareness of the practical applicability of academic subject matter, or could lower attainment because voca-

tional students spend less time in academic subjects that foster basic skill development.

Evidence to support or refute the claim that basic skill instruction in a vocational context improves basic skills of vocational students is extremely limited. A few reports suggest that instructional materials with practical, vocational content may be effective in improving basic skills of vocational students. In one study of 51 tenth-grade students in an area vocational-technical school, reading scores of experimental students who used a workbook with vocational content were found to have improved to a greater extent than those of control students who did not (Afrow, 1976). In another report, two English teachers described an English course for vocational-technical high school students in which students kept lists of words related to employment, simulated job interviews, and wrote reports on careers (Gere & Corrigan, 1978). In this way they increased their vocabulary and received practice in writing that was relevant to their career interests. A mathematics teacher of vocational-technical students also urged emphasis on practical application, adding that application should not be limited to highly specialized vocational areas (Mrachek, 1975). Rather, he encouraged his students to use mathematical concepts to aid decision making in practical situations, such as choosing a car to buy by determining the relative cost of gas required to drive cars with different advertised mileage rates a given distance. The actual effect of this teacher's precepts on students' behavior was not determined.

The use of reading materials written at a readability level consistent with high school vocational students' reading ability was found in one study to improve reading scores of 100 experimental students to a greater extent than scores of 40 control students (Morrell, Note 17). In another study, remedial reading was

found to be significantly positively related to reading ability of 115 postsecondary industry and technology students (Loran, 1977).

Under a two-year contract with the Office of Vocational and Adult Education, the Cornell Department of Education is presently developing sample lesson plans and teachers' guidebooks to assist vocational education teachers in teaching basic skills to vocational students. The effectiveness of these materials in improving students' basic skills will not be determined under this contract.

Little is known about characteristics which distinguish successful from unsuccessful efforts to improve vocational students' basic skills. Because of the small sample sizes used in the studies described previously, all warrant replication. Unfortunately, precise information on the nature of the instruction is sometimes lacking and replication cannot readily be carried out. At this time, then, few firm conclusions can be reached about particular teaching methods or instructional materials that are effective in improving basic skills of vocational students. The hypothesis that teaching basic skills in a vocational context effects improvement of these skills among vocational students remains to be adequately tested.

Conclusions

Verbal and computational skills are critical to the development of vocational students. A growing body of evidence is accumulating which substantiates the notion that proficiency in certain reading and computational skills is required for performance in all types of occupations. The ability to locate facts in written material and apply them to decision making on the job, to understand and convey directions for completing tasks, and to com-

pute with whole numbers is required in all occupations that have been surveyed (Generic Skills, 1977). The ability to communicate effectively and think logically has been found to distinguish supervisors from lower-level workers, a finding which suggests that this ability may be necessary for advancement beyond entry-level positions.

Information on the level of basic skill acquisition of students in different vocational programs in secondary school is necessary to determine whether there are gaps between the proficiency of students who are preparing for particular occupations and the demands placed on workers in those occupations, but this information is not yet available. At present there is no way of knowing the total number of students, or of identifying individual students, who may have failed to attain the level of competence in basic skills that is required in different jobs. It is known, however, that vocational education students in secondary school perform below average in reading comprehension, vocabulary, and mathematics. One State survey indicated that they perform below average in writing as well.

It could be that vocational education students function poorly in basic skills at the time they enter vocational programs in secondary school, if not long before. Since the vocational curriculum typically places much greater emphasis on specific occupational content than on basic skill instruction, some students may complete vocational programs with no greater proficiency in basic skills than that with which they enter. Longitudinal research is required to examine the basic skill development of vocational students as they progress through school, relative to the progress of students in other curricula, in order to know the extent to which participation in vocational programs modifies the level of skills possessed by students upon entry into the programs.

Successful efforts to improve the literacy and computational skills of vocational students would be likely to increase their chance of employment. Furthermore, these efforts could improve the competence of these students in performing required job tasks and ease later transfers from one job to another. Available information on basic skills of vocational students, however, leaves critical questions unanswered. What are the best ways to teach basic skills to vocational students? To what extent can basic skill instruction provided in secondary school to vocational students improve their basic skills? What methods are most likely to make this instruction successful?

Although research has not been conducted with vocational students to answer these questions directly, inferences can be drawn from related research conducted with young adolescents and adults. For example, research on compensatory education and adult literacy programs, whose participants also come from disadvantaged backgrounds, seems useful for this purpose. Research has shown that junior high school students in compensatory education programs are more likely than elementary school students to exhibit reading improvement (i.e., at least a one-month gain for each month in the program) which is sustained beyond one school year (Larson, Note 18). Characteristics of effective compensatory programs for junior high school students may suggest approaches for vocational students in secondary school. Larson (Note 18) reported that compensatory programs in which students were taken out of the classroom "have less to offer the adolescent student and his teacher than do other models" (p. 109). She explained this finding by noting that participating students were highly visible and thereby stigmatized, the teacher had no network of support, and other teachers tended to disclaim responsibility for basic skills instruction. Continuity of the program beyond one school year was strongly recommended.

Applicability of research on adult literacy programs to vocational students is limited, not only because participants in these programs are older but especially because they represent an extremely highly motivated fraction of the population (three to six percent) for whom these programs are designed (Hunter & Harman, 1979). Effective adult literacy programs are those with the following characteristics: teachers who show warm personal concern for their students and are familiar with problems of students from minority and disadvantaged backgrounds; materials prepared by students; unstructured approaches that focus on an individual student's assessment of his interests and needs and allow him to move at his own pace; and learners who believe they are responsible for their own successes and failures (Hunter & Harman, 1979). The Adult Basic Education program in Vermont was found to be effective with students who set their own reading goals, had a genuine interest in the material, and recognized that the skills they were learning were the ones needed to solve problems in their everyday lives (Eberle & Robinson, Note 19). Students' preferred mode of learning was one-to-one tutoring, particularly when offered in their homes.

It is not known to what extent characteristics of effective adult literacy programs, in which instruction is often highly individualized, would be effective with high school students in the classroom or in small groups. Nevertheless, although students above elementary school age may vary considerably in the skills they have previously mastered, vocational students would appear to have a common set of skill needs. These needs are in part dictated by the skills that are common requirements of the jobs they are being trained to perform. Research has recently begun to shed light on the basic skills required in most occupations, as well as skills particular to different occupations, and research in progress can be expected to provide more firm knowledge on this subject in the coming years. This knowledge can be used to suggest

some common goals of basic skill instruction for vocational students.

Several recommendations for improving research and instruction with vocational education students are supported by research on basic skills. First, basic skills must receive strong emphasis in vocational students' education. Not only are these skills of intrinsic educational value to all students, but reading and computational skills have been found to be widely applicable to most jobs, and advancement beyond entry-level positions has been found to be associated with effective communication skills. Second, effective techniques for teaching basic skills to vocational students must be identified. Awareness of the relevance of instruction to practical problem-solving is characteristic of successful learners in adult literacy programs. Perhaps the motivation of vocational students can be harnessed to improve their acquisition of basic skills, possibly through teaching which demonstrates the use of these skills in the jobs the students hope to enter. Third, vocational education students' levels of competence in basic skills should be assessed as they progress through school, to ensure that deficits are remediated or proficiency maintained. Fourth, measures of particular skills that have been found to be highly job-related, such as locating facts in text, ought to be used to supplement the more general reading tests, so that weaknesses in these areas can be identified. Finally, longitudinal research is needed to trace the basic skill development of vocational students as they progress through school, relative to progress of students in other curricula, in order to know whether these skills are enhanced or diminished by participation in vocational education programs. These steps appear to be necessary if vocational education is to prepare students not merely for jobs after graduation but for a lifetime of learning experiences.

Proficiency in basic skills is of potential benefit to both the individual and society. The individual who can read with understanding, write, and compute has a better chance of getting a job and better preparation for subsequent learning, both at school and at work, than a person with limited proficiency in basic skills. Improvement in the basic skills of individuals at the same time results in a more informed citizenry.

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